Citric Acid Alternative to Nitric Acid Passivation

Completed Technology Project (2011 - 2016)

Project Introduction

The Ground Systems Development and Operations (GSDO) Program at NASA John F. Kennedy Space Center (KSC) has the primary objective of modernizing and transforming the launch and range complex at KSC to benefit current and future NASA programs along with other emerging users. Described as the "launch support and infrastructure modernization program" in the NASA Authorization Act of 2010, the GSDO Program will develop and implement shared infrastructure and process improvements to provide more flexible, affordable, and responsive capabilities to a multi-user community.

Corrosion is an extensive problem that impacts National Aeronautics and Space Administration (NASA) and Department of Defense (DoD). The deleterious effects of corrosion result in steep costs, asset down-time affecting mission readiness, and safety risks to personnel. Consequently, it is vital to reduce corrosion costs and risks in a sustainable manner.

NASA and DoD have numerous structures and equipment that are fabricated from stainless steel. The standard practice for protection of stainless steel is a process called passivation which removes free iron contamination from the surface and forms a metal oxide layer to prevent corrosion. Typical passivation procedures call for the use of nitric acid which exhibits excellent corrosion performance; however, there are a number of environmental, worker safety, and operational issues associated with its use.

The longtime military specification (QQ-P-35C) for the passivation of stainless steel was cancelled in favor of newer specifications which allow for the use of citric acid in place of nitric acid. Citric acid offers a variety of benefits that include increased safety for personnel, reduced environmental impact, and reduced operational cost. There have been few studies, however, to determine whether citric acid is an acceptable alternative for NASA and DoD applications; therefore, NASA and DoD agreed to collaborate on an effort to validate citric acid as an acceptable passivating agent for stainless steel.

Anticipated Benefits

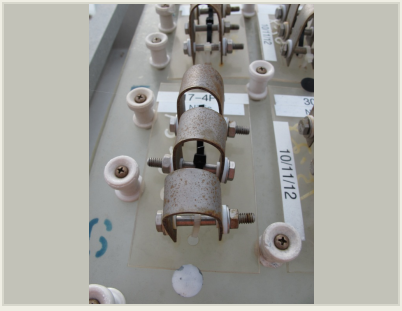
Benefits to NASA and other agencies include:

1. Citric acid reduces environmental, safety, and health risks and costs associated with the use of nitric acid.

2. Citric acid is a sustainable alternative that reduces material obsolescence risks.

3. Citric acid does not remove beneficial heavy metals from the passivated surface like nitric acid does.

4. Elimination of nitric acid (NOx) emissions considered greenhouse gases that contribute to smog and nitrogen loading (oxygen depletion) in bodies of



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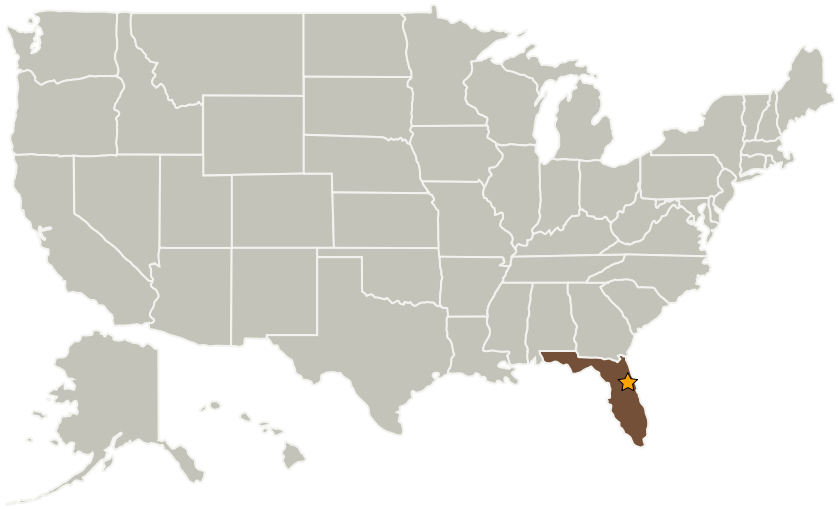
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Kennedy Space Center(KSC)	Lead Organization	NASA Center	Kennedy Space Center, Florida

Primary U.S. Work Locations
Florida

Organizational Responsibility

Responsible Mission Directorate:

Exploration Systems Development Mission Directorate (ESDMD)

Lead Center / Facility:

Kennedy Space Center (KSC)

Responsible Program:

Exploration Ground Systems

Project Management

Program Managers:

Thomas D Whitmeyer
Michael J Bolger

Project Manager:

William B Simmonds

Principal Investigator:

Luz M Calle

Co-Investigator:

Pattie L Lewis

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Images

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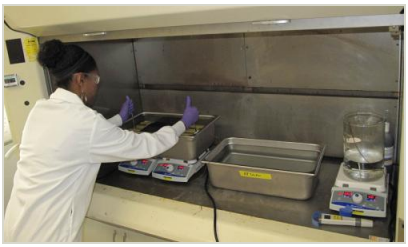
Citric Acid Alternative to Nitric Acid Passivation
(https://techport.nasa.gov/image/1899)



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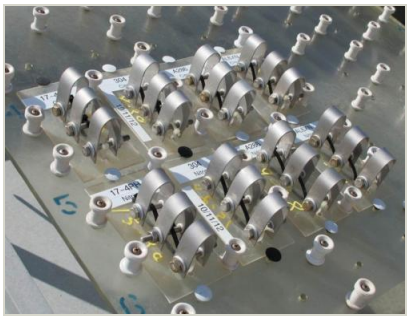

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Citric Acid Alternative to Nitric Acid Passivation
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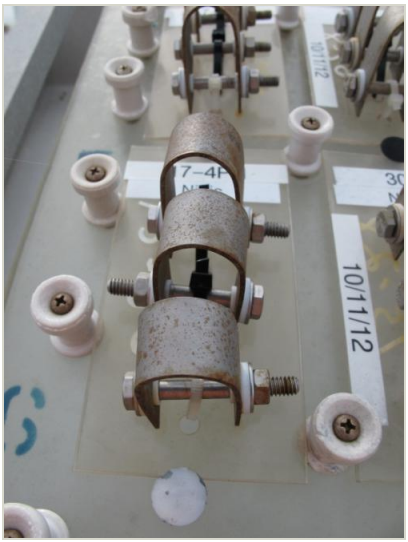

Citric Acid Alternative to Nitric Acid Passivation
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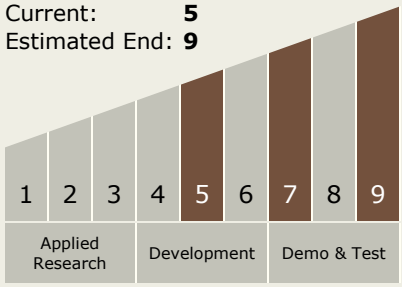
Technology Maturity (TRL)

Start: **7**
Current: **5**
Estimated End: **9**



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.1 Materials
    - TX12.1.5 Coatings

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Links

Technology Evaluation for Environmental Risk Mitigation (TEERM)
(http://teerm.nasa.gov/AltNitricAcidPassivation.htm)